

Claims

1. A switch comprising an integrated spatial light modulator for receiving light of a predetermined wavelength, the modulator comprising a liquid crystal layer spaced from a second layer by a layer having an optical retardance of an odd integer number of quarter-waves of said wavelength, wherein the second layer is reflective of said light of said wavelength.
2. The switch of Claim 1, wherein said liquid crystal layer is a nematic crystal layer.
3. The switch of claim 1 wherein said liquid crystal layer is a π -cell.
4. The switch of Claim 1 or 2, wherein the second layer is a metallic layer.
5. The switch of Claim 3 wherein the metallic layer is of Aluminium.
6. The switch of any preceding claim wherein said wavelength is 1.57 μm
7. A switch comprising an integrated spatial light modulator for receiving light of a predetermined wavelength, the modulator comprising a liquid crystal cell having a pair of opposed and mutually substantially parallel end plates disposed substantially parallel to an axial plane, and spaced apart by a liquid crystal layer providing a director angle tilt in a tilt plane substantially orthogonal to said axial plane, said liquid crystal being spaced from a second layer by an optical

layer having a retardance of an odd integer number of quarter-waves of said wavelength, wherein the second layer is reflective of said light of said wavelength, and the optical layer being disposed with respect to said tilt plane such that light polarised in said tilt plane returns through said liquid crystal layer polarised substantially orthogonal to said tilt plane.

8. The switch of Claim 7, wherein said liquid crystal layer is a nematic crystal layer.

9. The switch of claim 7, wherein said liquid crystal layer is a π -cell.

10 The switch of any of claims 7-9, wherein the second layer is a metallic layer.

11. The switch of Claim 10, wherein the metallic layer is of Aluminium.

13. The switch of any preceding claim, wherein the modulator has a glass cover disposed over said liquid crystal layer, and the metallic layer has a connection to driving circuitry for switching the modulator.

14. A method of switching a light beam having a first component polarised in a first direction and a second component polarised in a second direction orthogonal to the first, the method comprising providing a device having a liquid crystal layer and an integral optical retardance, the liquid crystal being responsive to a variable drive voltage to provide a corresponding variation in director angle tilt; and further comprising: applying a variable drive voltage to said liquid crystal device; applying said beam to said liquid crystal device

to provide an intermediate beam having a variable phase delay applied to said first component and an at least substantially fixed phase delay to said second component; by said retardance, rotating the polarisation of said intermediate beam; applying the resultant light to said liquid crystal device whereby a component of said resultant light polarised in said first direction receives said variable phase delay and a component of said resultant light polarised in said second direction receives said at least substantially fixed phase delay.

15. The method of Claim 14 wherein the rotating step comprises rotating said polarisation through 90 degrees whereby at least substantially equal amounts of variable phase delay are applied to each of said first and second components.

16. The method of claim 15 wherein the rotating step comprises a step of reflecting said intermediate beam back along its incoming path.

17. An optical switch comprising a plurality of input optical fibres for providing plural input light beams, a plurality of optical receivers for receiving output light beams, a first and a second reflective spatial light modulator, and drive circuitry for forming a respective plurality of switching holograms on each spatial light modulator, said holograms being selected to couple each said input optical source to a respective desired optical receiver, wherein each spatial light modulator incorporates a liquid crystal device for modulating the phase of light travelling through said liquid crystal device, a reflector device for returning light back through said liquid crystal device and a device, disposed between said liquid crystal device and said reflector

device, for rotating the polarisation of light by 90 degrees, wherein the optical switch has an axis of symmetry and the spatial light modulators are disposed on opposite sides of said axis, each said switching hologram on said first spatial light modulator being operative to deflect said input light beams to said switching holograms on said second spatial light modulator and each said switching hologram on said second spatial light modulator being operative to deflect said light beams to a respective optical receiver.

18. The switch of Claim 17, wherein each said input optical fibre is directed towards a respective switching hologram on said first spatial light modulator, and each said optical receiver comprises an output optical fibre, wherein each output optical fibre is directed towards a respective switching hologram on said second spatial light modulator.

19. The switch of Claim 17 or 18 wherein the first and second spatial light modulators are disposed such that a respective zero-order beam reflected from each switching hologram on said first spatial light modulator is incident on a respective switching hologram on said second spatial light modulator.

20. The switch of any of claims 17-19 wherein a half wave plate is disposed between said first and second spatial light modulators.

21. The switch of claim 17 wherein the switching holograms are spaced apart on said first and second spatial light modulators and the first and second spatial light modulators are disposed such that a respective zero-order beam reflected from each switching hologram on

said first spatial light modulator is incident on a spacing between two adjacent switching holograms on said second spatial light modulator.

22. The switch of any of Claims 17-21 and further comprising respective optical systems disposed between said input fibres and said first spatial light modulator and between said output fibres and said second spatial light modulator, wherein each said optical system comprises two confocal lenses, the input and output fibres being disposed in respective planes and a focal plane of a first lens of each optical system coinciding with the plane of the associated fibres.

23. The switch of any of claims 17-22 wherein the input and output fibres are disposed in respective planes and the optical switch further comprises respective arrays of microlenses, said microlenses being disposed in front of each fibre plane such that each microlens corresponds to a respective fibre, and respective optical systems disposed between said input fibres and said first spatial light modulator and between said output fibres and said second spatial light modulator, wherein each said optical system comprises two confocal lenses, and a focal plane of a first lens of each optical system coinciding with the output focal plane of the associated microlens array.

24. The switch of Claim 22 or 23 wherein said optical fibres are thermally expanded core (TEC) fibres.

25. The switch of claim 17 wherein the first and second spatial light modulators are mutually offset so that no zero order beams from the first spatial light modulator is incident on the second spatial light modulator.

26. The switch of claim 25, and further comprising at least one optical receiving element disposed in a region receiving said zero-order beams from said first spatial light modulator, whereby input signal may be monitored.

27. The switch of claim 26 wherein the or each element is a fibre.

28. The switch of any of Claims 17 -27 wherein each switching hologram provides a repeating pattern on its spatial light modulator, whereby the repeating patterns on the two SLMs satisfy the relation:

$$\theta_2(u) = \theta_1(-u)$$

where $\theta_2(u)$ is the repeating pattern on the second SLM and $\theta_1(-u)$ is the repeating pattern on the first SLM, and the angle of incidence is such that the Poynting vector of the input light beam incident on the first SLM, and of the light beams leaving the second SLM, is in the plane of tilt of the director.

29. The switch of any of claims 17-28 wherein the output fibres are secured together in an array by a glue containing black pigment to attenuate misaligned light.

30. The switch of any of claims 17-29 wherein the output fibres are secured together to form an array and the spacing between the fibres of the array is occupied by interstitial fibres which serve to accept and guide away cross talk from the switching zone.

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